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Program produces 'out-of-this-world' learning for students

by Timothy R. Anderl, Materials and Manufacturing Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — A school "residency" program, designed by an optics expert from the Air Force Research Laboratory's Materials and Manufacturing Directorate (ML) and a member of the Yellow Springs Community, led to 20 elementary school students designing a laser-based audio transmitter that traveled to space as part of a National Aeronautics and Space Administration program.

The program that led to student participation in the NASA Space Experiment Module (SEM) project was initiated by Dan Rudolf, a community member from Yellow Springs, Ohio, when he approached Dr. James Grote, an optics researcher from ML's Sensor Materials Branch, with his idea of a residency program.

In the past, scientists and engineers have held basic "attention-getting" demonstrations at local schools. However, these demonstrations are typically limited to an hour in length and provide little depth into basic understanding of scientific principles. The residency program would bring an experienced scientist or engineer into the classroom to teach the basics of his or her field, and to demonstrate concepts that students could apply to a project.

"I agreed to be the first scientist-in-residence for the program, and began teaching the fifth and sixth grade students at Mills Lawn Elementary School in Yellow Springs about light and lasers," Grote said. The laser residency was presented in three, 60 to 90 minute sessions, which included hands- on experiments for the students. The sessions were held every other day to provide the elementary school teacher time to help students with additional questions and to prepare them for the next lecture.

"Because I was working with elementary school students, the basics had to be presented conceptually and with very little math," Grote said. "This is the approach I used to teach the students what light is, why they are able to see it, the color and speed of light, refraction of light through various mediums, and about lasers and how they work. I also taught a little geometrical optics using concave and convex lenses and mirrors to demonstrate what laser light does when it encounters them."

Students performed many hands-on experiments to physically demonstrate the concepts they were learning. Laser-based equipment, such as a laser scanner, leveler and micrometer were also demonstrated.

When the week of lectures was complete, students wrote a paragraph detailing what they'd learned. Based on their essays and individual enthusiasm, a core group of 20 students were chosen by their teachers to work on a laser-based project. The project, which lasted a week or so, was to find a way of transmitting the output from the school's public address system to the school superintendent's office, 300 feet away and on the other side of the street.

After coming up with various options, like using walkie-talkies, wireless speakers, cell phones, intercom systems, and laser methods they'd learned during the lecture and demonstrations,

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Dr. James Grote and students from Mills Lawn Elementary School weigh and package a laser module for the Materials on the International in Space Station Experiment (MISSE). The experiments are going up on NASA mission STS-112 in August 2002. The experiments will be attached to the space station for three years to study effects of the space environment on lasers.

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the students met with the school principal and superintendent to propose the project. Students received a budget, researched the specifications and cost for each option, the procedures for getting permits, and even met with the village manager to estimate the cost of digging a trench across the street for installing electrical or fiber optic cable. The students decided that a free space laser-based audio transmitter would provide acceptable performance and would be the most cost-effective choice.

"Myself and a group of adult volunteers worked with the students to build and install the system. The students even simulated rain and snow to test the integrity of the transmitted signal," Grote said. "They were very excited to see their project work for the first time. When the project was complete, the students who comprised the core group presented what they had learned during the laser project to the rest of the school, their parents and members of the community."

During his second laser residency, Grote asked students to find applications for the laser-based audio transmitter. When space communications was suggested as an application, Grote, the teachers and students wrote a proposal for a passive experiment for the SEM program. The students developed and proposed their project to NASA, which would test space effects on laser diodes.

The proposal was accepted by NASA, which was significant since their proposal was in competition with high schools and even colleges. It was the only elementary school on this SEM program. As part of the SEM program, they were invited to the Kennedy Space Center to see the space shuttle carrying their project launched. The students characterized the wavelength and power of a laser diode at Wright Patterson Air Force Base before the launch, and since its return from space, the students have started re-characterizing the laser.

"My hope is that outreach activities, such as the laser residency and additional robotics, alternative energy and aerospace programs that have been held at Mills Lawn, will continue to plant a seed of interest in some of these students," Grote said. "Though this type of program requires time and commitment, seeing the results of a student's hard work launched into space was extremely exciting and rewarding for the students as well as the adults involved in the program.

"I strongly encourage any fellow scientist to get involved in their community schools, and to take on the challenges of mentoring a group of students. We are fortunate at Wright-Patterson Air Force Base to have an educational outreach office. They provide invaluable support for AFRL scientists like myself." **@**